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ESD GUIDE TO LIFE CYCLE COST (LCC) IN SOURCE SELECTION.(U)
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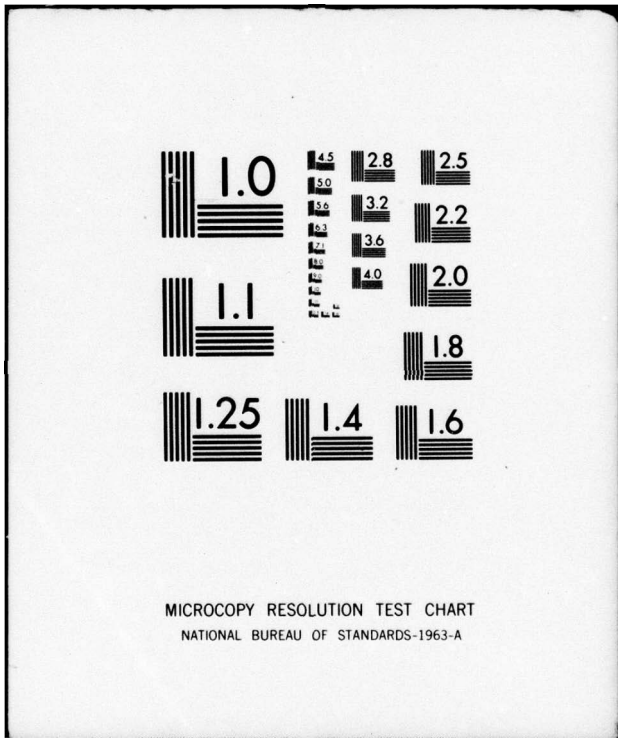
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ESD GUIDE TO LIFE CYCLE COST (LCC) IN SOURCE SELECTION

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Prepared for

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Attempts to outline in a very general sense the steps involved in incorporating Life Cycle Cost (LCC) into the source selection process. Covers the period from preparation of proposal through write-up of findings of Source Selection Evaluation Board. While the article should be of interest to anyone involved in LCC and the source selection process it is geared primarily to Communications-Electronic Systems procured at the Electronic Systems Division (ESD). The article is strictly narrative and requires very little quantitative background to understand.

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OVERVIEW

Operating and supporting today's modern weapon systems requires a disproportionate share of the defense budget. Moveover, there is relatively little that can be done about these costs. The weapon systems are vital to our national defense and will, therefore, be operated and maintained. In addition, short of extensive and costly modifications, the O&S requirements are inherent in the systems designs.

While we have little or no control over existing budget requirements, we can influence future ones. To do so requires that we expand our procurement perspective in the selection of new systems. The technique involved is called Life Cycle Cost (LCC). Simply put, LCC attempts to address and give visibility to all system related costs - both present and future.

There has been a great deal of recent emphasis on the need for and benefits of LCC. Unfortunately, the bulk of the material is addressed to the top management level. There has been relatively little written on the specifics of just how to implement these concepts. Naturally the techniques required will vary as to the purpose of the LCC calculations - budgeting for future fund requirements, comparing the costs of alternative weapon systems while in the conceptual stage, deciding between modifying an existing system or replacing it, and as a factor to be used in source selection.

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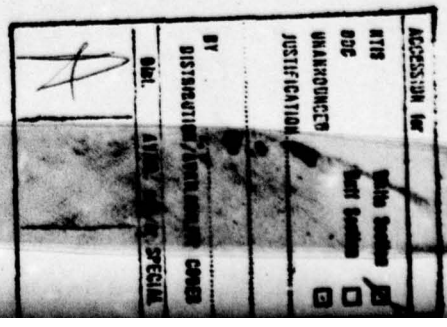

This article will attempt to cover the use of LCC in one specific area - source selection. It is addressed to the individual tasked with the responsibility for LCC and who will participate as a member of the Source Selection Evaluation Board (SSEB).

A word of warning, the guide is by no means intended as a cure-all for LCC for all programs here at ESD. It merely attempts to outline some of the techniques that have proven successful in the past and to present some of the errors made in the hope that they will not be repeated.

GENERAL

Life Cycle Cost is nothing more than the sum of all system related costs - development, acquisition, installation, operation, support, and retirement. In applying LCC to a source selection, we seek to broaden the traditional emphasis on acquisition cost alone.

- What effect will a system's design have on future maintenance cost?
- What will be the cost of initial spares?
- How many of the spares will have to be condemned, and therefore replaced, over the life cycle?
- How many of the assemblies and parts will be new to the DOD inventory and what effect will this have on inventory entry and item management costs?
- What will be the cost to modify existing equipment or facilities to accommodate the new equipment?

LCC seeks to answer these and a number of other similar questions during the source selection process. The goal is to present the Source Selection Authority (SSA) with an expanded cost picture on which to base his selection. To adequately address these costs in a source selection requires a good deal of time and effort. The process begins a year or so before the formal solicitation of proposals is released to industry.

PREPARATION OF THE LCC PLAN

KNOWLEDGE OF THE SYSTEM. The structure of the LCC evaluation plan depends upon a great many factors: the type of system being acquired; the degree to which the system to be acquired has been previously developed; the need for additional development; the possible need for MTBF guarantees, Reliability Improvement Warranties, etcetera. The number of factors to be considered demands that LCC techniques be tailored to the particular system at hand. To do so requires that we first study the system itself. This means acquiring knowledge of the technical aspects of the equipment, the operational demands it must satisfy, the using command's maintenance policies, and other such pertinent facts. In short, a thorough understanding of the system. To further complicate matters, everything is in a state of flux. This early in the program, the maintenance philosophy is not firmly established, the exact number of systems to be bought may depend upon budget considerations, spare quantities may depend upon just what the cost of the spares turn out to be, etcetera. Regardless of the uncertainty involved, a good place to start is by reading the ROC, the PMD, the PMP, program cost studies, and any other documents available on the system. Augment that with discussions with the technical people, the logistics people, and the users. In short, before you do anything else insure that you have a good idea of just what the system is that you will attempt to model. Once you have enough general knowledge to ask intelligent questions, you can start to think about what the important cost elements will be.

COST ELEMENTS

Cost elements are merely a convenient classification of costs by type. Examples might include the following:

- Development
- Acquisition
- Initial Spares and Replacement Spares
- Maintenance
- Data and Data Rights
- Support Equipment
- Training
- Modifications to Existing Equipment and Facilities
- Site Preparation and Installation

The list could easily be expanded in both scope and detail for even the simplest of systems. Ultimately, one would arrive at the total LCC. However, to do so for source selection purposes is both fruitless and impractical. Expanding upon the number and complexity of the cost elements addressed will impact upon the complexity of the computer program, the data required, and the time necessary to evaluate LCC.

The following points should be kept in mind when attempting to identify cost elements which will be significant in comparing the various possible design approaches which may be offered by industry.

- Is it reasonable to expect that the cost element will represent a significant percentage of the LCC?
- Will the cost element vary significantly from offeror to offeror depending upon specific system designs, maintenance requirements, installation efforts, etcetera?
- Is it necessary to shred out the cost separately or would it be equally effective (for purposes of visibility) to combine several costs under one heading?
- If control of LCC is to be achieved by a special contract provision, can the cost be objectively verified?

If you find yourself floundering in trying to establish just what the significant cost elements are, go back to square one, knowledge of the system. If you really understand the system itself, the appropriate cost breakout should be apparent.

LCC MODELS

There are a number of different LCC models in existence and the reader should have no trouble finding them. For the most part they are straightforward accounting type models that require little more than an understanding of college algebra. However, the field is just too broad to adequately cover in a guide of this size. Once you have determined the important cost elements for your program, spend some time surveying the literature available on LCC models. The exposure to the variety of models and their authors will broaden your background in the field and the potential benefits and shortcomings of each approach.

A word of warning - don't be bound to any particular model.

People have a tendency to pick up an existing LCC model and "cut-and-paste" to fit their particular requirement. I believe it much better to proceed as recommended - start with the system itself, proceed to the cost elements, and finally to the equations. If we start with a model, we become prematurely committed to a specific approach. All too often it may not be the right one. The danger becomes more apparent when we consider where the majority of the existing models were developed and what they were designed to do.

The basic concepts of LCC analysis were developed in an environment of aircraft acquisition. Consequently, the tools and techniques developed to implement these concepts were structured to be used for a specific purpose - the analysis of aircraft associated costs. As time progressed, the models matured and the mathematical equations became more sophisticated. Ultimately, these models became the standard for all aircraft LCC analysis. In our effort to stay abreast, we here at ESD adopted these proven techniques, sometimes forgetting that they were proven in an aircraft environment.

The models available, their cost elements, and the equations employed therein are basically aircraft-oriented and, for the most part, ill-suited for our use. As way of example, consider the Logistics Support Cost (LSC) model, an extremely sophisticated and useful tool, when used for its intended purpose.

In the majority of LCC models, the breakout of Cost Elements (CE) is as follows:

(1) Spares (Initial and Replacement)

(2) On-equipment Maintenance

(3) Off-equipment Maintenance

(4) Inventory Management Cost

(5) Data Costs

(6) Support Equipment

(7) Training

(8) Cost of Facilities

(9) Cost of Fuel Consumption

(10) Spare Engine Cost

This breakout of costs seems appropriate enough when dealing with aircraft. It adequately "models" the aircraft operating and maintenance environment and addresses all the significant costs. How then do we "tailor" the model to electronic systems? We naturally drop the cost elements for fuel and engines. Yet we have continued to employ the remaining cost elements pretty much as they stand. I suggest that this approach is more convenient than appropriate.

As an example, consider the 2nd and 3rd cost elements - on and off equipment maintenance respectively. When dealing with aircraft, the breakout proves useful in that it gives us some visibility as to the amount of time the aircraft itself

will be down for maintenance. In some electronic systems this may be equally important to know. However, in the majority of electronic systems there is a sufficient degree of redundancy to allow the equipment to operate while a portion of it is being worked on. In addition, with aircraft, the on and off equipment maintenance is done by separate groups of people. Not so for electronic systems. The same maintenance shop is responsible for all the work. Hence, the on/off equipment maintenance breakout serves no purpose. For the sake of visibility would it not be better to talk of base and depot maintenance costs? Base costs could in turn be broken out as scheduled and unscheduled maintenance costs. Or perhaps, where the equipment is far removed from the intermediate maintenance facility, a breakout of travel time costs, remove and replace or repair time costs, and shop maintenance time costs would be appropriate. The point is that the breakout should match the operational and maintenance conditions.

In cost elements CE 1 and CE 6 (of the LSC model) for the computations of initial spares and peculiar support equipment we go through some rather laborious calculations. For aircraft, where we may be talking several of each item (spares and support equipment) for the use of the maintenance squadron, it seems necessary. Yet in our circumstances, where we are talking about a single unit of electronics gear per base, why go through

the math? The question may be one or none of a particular piece of support equipment. The same may be true of spares. The math will not answer the question (one or none) but merely provide us with some fractional number somewhere between. It then requires some common sense to decide. I suggest we simplify the process.

The concept of LRU and SRU, so necessary to aircraft analysis, also may be artificial to our needs. In many cases where there is a maintenance facility or workbench collocated with the operational equipment, where does one draw the line? Moreover, it presents the contractors with the problem of having to categorize their equipment in this artificial manner. There is no clear criteria such as repair level or WBS level. The distinction may be useless and confusing. Why not merely talk of the items that require scheduled maintenance, those subject to failure, and those to be repaired and stocked?

As you can see, the dangers and pitfalls associated with starting with a particular LCC model are numerous. Suffice it to say that they can be avoided, or at least minimized, by taking the approach outlined previously - system, cost elements and finally equations and model. The important thing is to insure that the equations you use and the model you develop fit the task at hand.

Having completed your survey of models available and having developed your math model you must now validate it. This is nothing more than checking to insure that it adequately depicts the real world system. In so doing have a number of people check

it. A word of warning - don't limit the validation process to individuals who understand the math involved. Get with the individuals who understand the maintenance concept to be applied, the support equipment specialists, the users who establish the operational guidelines, etc.... If necessary, sit down and walk them through the math involved. It's your responsibility to insure that the model reflects the real world. It's well worth your time and effort to check and recheck it.

LCC PROGRAM

Having a LCC model merely tells you what cost elements you will cover and how you will calculate them. To actually exercise the model for a system of even modest size requires a great deal of repetitious and time consuming calculations. This is something that a computer does very well. The task now at hand is to create a computerized program of your LCC model. At this stage of the game, unless you are an accomplished programmer, seek help. Programming it yourself will teach you a great deal about programming, but will also consume a great deal of your time. An experienced programmer will have very little trouble with the modest size program required. This does not mean, however, that you are free and clear. Now is the time to think of how you want your output displayed, what data you will require to exercise the program, where it will be run, who will punch up the computer cards, etc... In programming the model keep the following points in mind.

DATA

- List, in alphabetical order, the mnemonic names of all variables used in your program along with their definitions.
- Identify those variables whose values are defined by the government and those to be defined by the contractor in his proposal. (Perhaps an asterisk (*) attached to those of the government).
- Along with those variables to be defined by the government, list a reference - Air Force Regulation, ALC contact, user specification, etc...
- Spell out just how you want your data submitted. Preferably have them submit punched computer cards and a listing thereof according to a format you specify.

PROGRAM

- If at all possible have your computer program written so that it will run in a time sharing mode. If not, keep it as small as possible (core wise) to insure reasonable turn-around time.
- Use dummy dimensions in the various subroutines and functions so that they can be set along with the input data. This will save you a great deal of editing or key punching once you are in source selection.

- Have the output(s) listed as options in the program. That way you won't have to go back and modify your program to delete outputs that you won't require on each and every run.
- Include a fair number of comment statements in the program itself to explain its internal operation. This is particularly helpful if you intend to furnish the program to the offerors with the solicitation.
- An echo check of the input data is always useful. This is nothing more than a printout of the data as it is read in. It gives you by system or LRU such information as MTBF, MTTR, RTS, NRTS, COND, Weight, scheduled maintenance interval by LRU or SRU or whatever you might find convenient. This should be included as an option since you won't always want it.
- Keep in mind that in your discussions with the technical SSEB panel you will be using this computer output as reference material. Therefore, arrange for it to be in a format that can be shared with them, i.e., keep it cost sterile. This is a good example of a useful option in the program - one echo check with unit prices included and one with the prices omitted.

RFP PREPARATION

Now that you have programmed your LCC model and exercised it with dummy data (and debugged it!) you are ready to include it in the RFP.

Keep the following points in mind:

- LCC should be reflected in the evaluation criteria (Section D of the RFP).
- The model itself belongs as an attachment to the RFP.
- The requirement for LCC belongs in the Instruction for Preparation of Proposal. (This applied to LCC used in the source selection process. When LCC is to be used by the contractor in the performance of the contract any reference to it belongs in the SOW).
- Any special provisions such as guarantees belong in Section J of the model contract.

At the very least, you should provide the offerors the LCC model and the government defined factors to be used in source selection. This insures a common baseline among offerors. All offerors will then be addressing the same cost elements and calculating costs the same way. Hopefully, you will have programmed it and debugged it. If so, furnish the offerors with a listing of the program or better yet with a card deck. This will save them time and effort during proposal preparation and let them concentrate on LCC trade-offs and not programming. Remember they have only 45-60 days in which to prepare their proposals.

In any event, spell out for them just how you want the data to be submitted. This should include both formats of the results he has obtained and formats for the data you need to exercise the LCC program in verifying his submission. If at all possible have him prepare and submit a data deck (remember to have him sequence it,

interpret it, and include a data listing!). If he is using the program you provided, he will have already prepared a data deck. He need only dupe it and submit it along with his proposal.

PREPARATION FOR SOURCE SELECTION

Once the RFP is prepared you can now concentrate on preparing for the source selection itself. A little thought given to just what you will be doing during the source selection and some planning for it will save you a great deal of time and effort. Your first goal should be to educate the chairman and members of the SSEB and SSAC on LCC in general and your approach in particular. In so doing, stress the fact that LCC seeks to take a comprehensive look at the whole system. This comprehensive look at LCC must be broken down into manageable tasks just as the various other disciplines are.

In planning the usual assignments for the SSEB, the effort is broken down to specific tasks and selected individuals assigned by name to each and every one of them. However, all too often the task matrix lists only one name for LCC - yours!

A solution to the problem is to have designated individuals on the logistics and technical panels as contacts for LCC. In accordance with ESD policy, they will not be permitted access to the total cost proposal and in fact, will be denied access to any portion of cost information unless absolutely necessary to the completion of their portion of the evaluation. They can then be light loaded with other functional tasks so that they can dedicate a portion of their time to assisting you. Their specific function would consist of checking such factors as work breakdown structure,

MTBF, MTTRs, RTS and NRTS rates, etc... They will also be able to better evaluate the need for and/or adequacy of support, equipment, site preparation requirements, scheduled maintenance requirements, etc... All they are really doing is insuring that the data you will use as inputs in your calculations is sound and reasonable. But then, after all, that's about 90% of LCC in source selection.

EVALUATION

Once you have received the proposals you at last have an indication of just how successful your preparation has been. Hopefully, the figures presented will be meaningful, accurate, and comparable.

Your first task then should be to insure that the proposals contain all the information you requested in the format you specified. Any deviation should be noted as it may require a discrepancy report or request for clarification.

Next, check to see that the information provided in your LCC data is consistent with that contained in other sections of the proposal. This check on internal consistency is one major area where members of the technical and logistics panels can assist. (NOTE: This is one of your first tasks. This is why you have specific individuals identified on the other panels to assist).

Having assured yourself that the data is reasonable you now run it against your LCC program. The results serve as an audit on the LCC bids submitted in the proposal. Any difference between

your results and the estimates submitted must be accounted for by either you or the contractor.

Having gotten this far, you have in effect filled the square marked LCC. However, the difference between filling the square and providing some useful information depends to a large extent on where you go from here. The objectives will vary from program to program, but should have a common goal - provide greater visibility to the SSA. The following list consists of points to be considered as time permits. They are not necessarily listed in order of priority.

- Identify parameters that seem to be the cost drivers - MTBF, unit price, utilization rate, etc... A sensitivity analysis will demonstrate the degree of impact upon LCC.
- Check on operational and maintenance constraints. Perhaps the user doesn't realize what his insistence on self sufficiency translates to in $$$. Perhaps a slight modification to "remove and replace" time would result in a considerable savings in spare costs.
- Using the data assessments obtained from the logistics and technical panels, exercise the model to obtain an estimate for a "most probable" LCC for each of the offerors.
- Based on the data presented what sort of case can be made for an RIW, MTBF guarantee, etc...? It is not necessarily too late to structure the required clauses for the contract,

but admittedly it's an 11th hour effort. Any such revision to the LCC approach, source selection, or contract requirement must be added to the government's requirements by RFP amendment thereby affording the offerors an opportunity to amend their proposals and extend negotiations.

WRITE-UP

The evaluation on LCC is strictly narrative in nature. You will not be required to rate the various offerors against a standard or evaluate them on a numerical scale. You merely report the results of your evaluation and include the various cost schedules you have arrived at. Then let the figures speak for themselves.

Any sensitivity analysis or analysis of contractual provisions must be explained. Just why is the MTBF of a particular configuration item a driving factor? What effects do the user's maintenance guidelines have on sparing costs? Will any option to have an MTBF guarantee be worth exercising? These are the types of questions that you should attempt to answer in your report and briefing.

LESSONS LEARNED

Having gone through a source selection you will be well aware of the lack of and need for guidelines on the application of LCC techniques. You have undoubtedly learned a few things that would be of benefit to someone else. By all means write them up as lessons learned - both the good points and the bad. The only way we will be able to avoid repeating the same mistakes is to educate others on the potential problem areas. Your lessons learned will hopefully help others to better the technique and improve the situation somewhat.